PATENT APPLICATION

PATENT COOPERATION TREATY

Applicant:
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Title: COAXIAL FRICTION CLUTCH ACTUATOR SYSTEM

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Commissioner for Patents
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Alexandria, VA 22313-1450

AMENDMENT UNDER ARTICLE 34

Dear Sirs:

Applicant makes the following amendments to the above referenced Patent Cooperation Treaty ("PCT") Application pursuant to Article 34. Cross reference to priority of PCT application has been added to the cover page. Claims 3, 9-10, 12 and 31 have been amended. No new matter and no new claims have been added. Please substitute the replacement sheets attached.

Respectfully submitted,

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Coaxial Friction Clutch Actuator System

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority from PCT/US03/38984 filed December 9, 2003, which claims priority from U.S. Provisional Patent Application No. 60/431,853 filed December 9, 2002, from U.S. Provisional Patent Application No. 60/436,158 filed December 23, 2002 and from U.S. Provisional Patent Application No. 60/444,789 filed February 4, 2003.

TECHNICAL FIELD OF THE INVENTION

This invention relates to actuator systems, and more specifically to actuator systems to actuate friction clutches.

DESCRIPTION OF THE RELATED ART

Electronically controlled actuator systems are presently used in vehicles to control starting clutches. These actuator systems require powerful motors despite the incorporation of spring means intended to counterbalance the reaction force applied to the release bearing by the control fingers of the clutch. These actuator systems are bulky and need to be mounted on the outside of the clutch housing, and are, therefore, expensive to manufacture.

The present invention is directed to overcome one or more of the problems set forth above.

What is claimed is:

1. (Currently Amended) In a controlled linear actuator system ~~(300,400,500,600)~~ for actuation of a friction clutch ~~(20)~~ having a housing, control fingers ~~(21)~~, and a clutch axis ~~(301,401,501,601),~~ the actuator system is characterized by:

a screw drive ~~(310,410,510,610)~~ generally coaxial with the clutch axis and including a collar ~~(312,412,512,612)~~ and a screw ~~(311,411,511,611)~~, said screw fastened to the housing;

a friction plate ~~(303,403,503,603)~~ arranged generally coaxial with the clutch axis and fastened to the control fingers for rotation therewith;

said collar having an associated first bearing race ~~(322,422,522,622)~~ with a bearing race axis offset from the clutch axis;

a second bearing race ~~(321,421,521,621)~~ in frictional engagement with said friction plate; and

a plurality of bearings associated with said first and second bearing races.

2. (Currently Amended) In a controlled linear actuator system ~~(300,400,500,600)~~ for actuation of a friction clutch ~~(20)~~ having a housing, control fingers ~~(21)~~, and a clutch axis ~~(301,401,501,601),~~ the actuator system is characterized by:

a screw drive ~~(310,410,510,610)~~ generally coaxial with the clutch axis and including a collar ~~(312,412,512,612)~~ and a screw ~~(311,411,511,611)~~, said screw fastened to the housing;

a friction plate ~~(303,403,503,603)~~ fastened to the control fingers for rotation therewith;

said collar having an associated first bearing race ~~(322,422,522,622)~~ with a bearing race axis ~~(302,402,502,602)~~ generally coaxial with the clutch axis;

said friction plate having a friction plate axis ~~(302,402,502,602)~~ offset from the clutch axis and having an associated second bearing race ~~(321,421,521,621)~~ in frictional engagement therewith; and

a plurality of bearings ~~(323,423,523,623)~~ associated with said first and second bearing races.

3. (Currently Amend) The actuator system according to claim~~s~~ 1 ~~or 2,~~ wherein the screw drive has a continuously variable pitch.

4. (Currently Amended) In an actuator system ~~(300,400,500,600)~~ for actuating a clutch ~~(20)~~, the clutch having a clutch axis ~~(301,401,501,601)~~, a friction disc and a pressure plate, the pressure plate having control fingers ~~(20)~~ for engaging and releasing the pressure plate, the actuator system is characterized by:

a screw drive assembly ~~(310,410,510,610)~~, said screw drive assembly having a screw drive assembly axis;

a friction plate ~~(303,403,503,603)~~ operatively connected to the control fingers for rotation therewith, said friction plate having a friction plate axis;

a bearing assembly ~~(320,420,520,620)~~ operatively connected to said friction plate and to said screw drive assembly; said bearing assembly having a bearing assembly axis; and

at least one of said friction plate axis, said screw drive assembly axis, or said bearing assembly axis being offset from the clutch axis.

5. The actuator system according to claim 4, wherein said offset is constant.

6. The actuator system according to claim 4, wherein said offset is variable.

7. The actuator system according to claim 4, wherein said screw drive assembly is a ball ramp.

8. (Currently Amended) The actuator system according to claim 4, wherein said bearing assembly is intermediate **to** said friction plate and said screw drive assembly.

9. (Currently Amended) The actuator system according to claim ~~4~~ **1**, wherein said friction plate axis is offset from the clutch axis.

10. (Currently Amended) The actuator system according to claim ~~4~~ **1**, wherein said bearing assembly axis is offset from the clutch axis.

11. The actuator system according to claim 4, wherein said bearing assembly has a first race and a second race, said second race being in frictional engagement with said friction plate.

12. (Currently Amended) The actuator system according to claim ~~4~~ **1**, wherein said screw drive assembly axis is offset from the clutch axis.

13. The actuator system according to claim 12, wherein said bearing assembly axis is offset from the clutch axis.

14. The actuator system according to claim 4, wherein said bearing assembly includes a friction ring.

15. The actuator system according to claim 14, wherein said friction ring is made

of a dry friction material.

16. The actuator system according to claim 14, wherein said friction ring is made of a PTFE-based metal-polymer material.

17. The actuator system according to claim 14, wherein said friction ring is made of a graphite material.

18. The actuator system according to claim 4, wherein said screw drive assembly includes a screw and collar, said screw having a pitch other than zero.

19. The actuator system according to claim 18, wherein said screw pitch is constant.

20. The actuator system according to claim 18, wherein said screw pitch is variable.

21. The actuator system according to claim 18, wherein said screw drive assembly includes a plurality of balls intermediate to said screw and said collar.

22. The actuator system according to claim 21, wherein said collar includes spiral grooves.

23. The actuator system according to claim 4, further including a worm gear reduction assembly operatively connected to said screw drive assembly.

24. The actuator system according to claim 23, wherein said worm gear reduction assembly includes a worm and a gear.

25. The actuator system according to claim 24, wherein said screw drive assembly includes a collar.

26. The actuator system according to claim 25, wherein said worm gear reduction assembly includes a housing that at least partially surrounds said collar.

27. The actuator system according to claim 25, wherein said gear is fastened to said collar.

28. The actuator system according to claim 25, wherein said gear is machined in said collar.

29. The actuator system according to claim 25, further comprising a shaft operatively connected to said worm.

30. The actuator system according to claim 29, further comprising a motor operatively connected to said shaft.

31. (Currently Amended) In an actuator system ~~(300,400,500,600)~~ for actuating a clutch ~~(20)~~, the clutch being intermediate to an engine ~~(10)~~ and a gearbox ~~(11)~~, the clutch

having a clutch axis ~~(301,401,501,601)~~, a friction disc and a pressure plate, the pressure plate having control fingers ~~(21)~~ for engaging and releasing the pressure plate, the actuator system is characterized by:

a friction plate ~~(303,403,503,603)~~ operatively connected to the control fingers for rotation therewith, said friction plate having a friction plate axis;

a screw drive assembly ~~(310,410,510,610)~~ having a screw drive assembly axis, said screw drive assembly including a flange operatively connected to the gearbox and said screw drive assembly further including a screw ~~(311,411,511,611)~~ and a collar ~~(312,412,512,612)~~;

a worm gear reduction assembly ~~(330,430,530,630)~~ having a worm ~~(331,431,531,631)~~ and a gear ~~(332,432,532,632)~~, said gear operatively connected to said collar of said screw drive assembly;

a bearing assembly ~~(320,420,520,620)~~ having a first bearing race ~~(322,422,522,622)~~ and a second bearing race ~~(321,421,521,621)~~, said first bearing race operatively connected to said screw and said second bearing race operatively connected to said friction plate, said bearing assembly having a bearing assembly axis; and

at least one of said friction plate axis, said screw drive assembly axis, or said bearing assembly axis being offset from the clutch axis.

32. The actuator system according to claim 31, said offset creating a first torque biasing said screw drive assembly in a first direction.

33. The actuator system according to claim 32, said offset creating a second torque biasing said screw drive assembly in a second direction.

34. The actuator system according to claim 33, wherein said first torque is balanced with said second torque.

35. The actuator system according to claim 34, said worm gear reduction assembly mediating axial travel of said friction plate.

Coaxial Friction Clutch Actuator System

ABSTRACT OF THE INVENTION

A controlled actuator system ~~(300, 400, 500, 600)~~ for the actuation of a friction clutch ~~(20)~~ comprising a screw drive assembly ~~(310,410,510,610)~~ coaxial with an axis ~~(301,401,501,601)~~ of the clutch ~~(20)~~ composed of a collar ~~(312,412,512,612)~~ and a screw ~~(311,411,511,611)~~ fastened to a gearbox ~~(11)~~. The controlled actuator system ~~(300, 400, 500, 600)~~ having a friction plate ~~(303,403,503,603)~~ rotatably fastened to control fingers ~~(21)~~ of the clutch ~~(20)~~ and coaxial with the clutch axis ~~(301,401,501,601)~~ and a ball bearing assembly ~~(320,420,520,620)~~ with a first race ~~(322,422,522,622)~~ fastened to the collar ~~(312,412,512,612)~~ and the axis of the bearing assembly ~~(320,420,520,620)~~ being offset from the axis ~~(301,401,501,601)~~ of the clutch ~~(20)~~. The collar ~~(312,412,512,612)~~ is rotated by a motor ~~(80)~~. The friction plate ~~(303,403,503,603)~~ and a second race ~~(321,421,521,621)~~ of the bearing assembly ~~(320,420,520,620)~~ are in frictional engagement.

Coaxial Friction Clutch Actuator System

CROSS-REFERENCE TO RELATED APPLICATIONS

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TECHNICAL FIELD OF THE INVENTION

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DESCRIPTION OF THE RELATED ART

Electronically controlled actuator systems are presently used in vehicles to control starting clutches. These actuator systems require powerful motors despite the incorporation of spring means intended to counterbalance the reaction force applied to the release bearing by the control fingers of the clutch. These actuator systems are bulky and need to be mounted on the outside of the clutch housing, and are, therefore, expensive to manufacture.

The present invention is directed to overcome one or more of the problems set forth above.

What is claimed is:

1. (Currently Amended) In a controlled linear actuator system for actuation of a friction clutch having a housing, control fingers, and a clutch axis, the actuator system is characterized by:

a screw drive generally coaxial with the clutch axis and including a collar and a screw, said screw fastened to the housing;

a friction plate arranged generally coaxial with the clutch axis and fastened to the control fingers for rotation therewith;

said collar having an associated first bearing race with a bearing race axis offset from the clutch axis;

a second bearing race in frictional engagement with said friction plate; and

a plurality of bearings associated with said first and second bearing races.

2. (Currently Amended) In a controlled linear actuator system for actuation of a friction clutch having a housing, control fingers, and a clutch axis, the actuator system is characterized by:

a screw drive generally coaxial with the clutch axis and including a collar and a screw, said screw fastened to the housing;

a friction plate fastened to the control fingers for rotation therewith;

said collar having an associated first bearing race with a bearing race axis generally coaxial with the clutch axis;

said friction plate having a friction plate axis offset from the clutch axis and having an associated second bearing race in frictional engagement therewith; and

a plurality of bearings associated with said first and second bearing races.

3. The actuator system according to claim 1, wherein the screw drive has a continuously variable pitch.

4. (Currently Amended) In an actuator system for actuating a clutch, the clutch having a clutch axis, a friction disc and a pressure plate, the pressure plate having control fingers for engaging and releasing the pressure plate, the actuator system is characterized by:

a screw drive assembly, said screw drive assembly having a screw drive assembly axis;

a friction plate operatively connected to the control fingers for rotation therewith, said friction plate having a friction plate axis;

a bearing assembly operatively connected to said friction plate and to said screw drive assembly; said bearing assembly having a bearing assembly axis; and

at least one of said friction plate axis, said screw drive assembly axis, or said bearing assembly axis being offset from the clutch axis.

5. The actuator system according to claim 4, wherein said offset is constant.

6. The actuator system according to claim 4, wherein said offset is variable.

7. The actuator system according to claim 4, wherein said screw drive assembly is a ball ramp.

8. (Currently Amended) The actuator system according to claim 4, wherein said bearing assembly is intermediate to said friction plate and said screw drive assembly.

9. (Currently Amended) The actuator system according to claim 1, wherein said friction plate axis is offset from the clutch axis.

10. (Currently Amended) The actuator system according to claim 1, wherein said bearing assembly axis is offset from the clutch axis.

11. The actuator system according to claim 4, wherein said bearing assembly has a first race and a second race, said second race being in frictional engagement with said friction plate.

12. (Currently Amended) The actuator system according to claim 1, wherein said screw drive assembly axis is offset from the clutch axis.

13. The actuator system according to claim 12, wherein said bearing assembly axis is offset from the clutch axis.

14. The actuator system according to claim 4, wherein said bearing assembly includes a friction ring.

15. The actuator system according to claim 14, wherein said friction ring is made of a dry friction material.

16. The actuator system according to claim 14, wherein said friction ring is made of a PTFE-based metal-polymer material.

17. The actuator system according to claim 14, wherein said friction ring is made of a graphite material.

18. The actuator system according to claim 4, wherein said screw drive assembly includes a screw and collar, said screw having a pitch other than zero.

19. The actuator system according to claim 18, wherein said screw pitch is constant.

20. The actuator system according to claim 18, wherein said screw pitch is variable.

21. The actuator system according to claim 18, wherein said screw drive assembly includes a plurality of balls intermediate to said screw and said collar.

22. The actuator system according to claim 21, wherein said collar includes spiral grooves.

23. The actuator system according to claim 4, further including a worm gear reduction assembly operatively connected to said screw drive assembly.

24. The actuator system according to claim 23, wherein said worm gear reduction assembly includes a worm and a gear.

25. The actuator system according to claim 24, wherein said screw drive assembly includes a collar.

26. The actuator system according to claim 25, wherein said worm gear reduction assembly includes a housing that at least partially surrounds said collar.

27. The actuator system according to claim 25, wherein said gear is fastened to said collar.

28. The actuator system according to claim 25, wherein said gear is machined in said collar.

29. The actuator system according to claim 25, further comprising a shaft operatively connected to said worm.

30. The actuator system according to claim 29, further comprising a motor operatively connected to said shaft.

31. In an actuator system for actuating a clutch, the clutch being intermediate to an engine and a gearbox, the clutch having a clutch axis, a friction disc and a pressure plate, the pressure plate having control fingers for engaging and releasing the pressure plate, the actuator system is characterized by:

a friction plate operatively connected to the control fingers for rotation therewith, said friction plate having a friction plate axis;

a screw drive assembly having a screw drive assembly axis, said screw drive assembly including a flange operatively connected to the gearbox and said screw drive assembly further including a screw and a collar;

a worm gear reduction assembly having a worm and a gear, said gear operatively connected to said collar of said screw drive assembly;

a bearing assembly having a first bearing race and a second bearing race, said first bearing race operatively connected to said screw and said second bearing race operatively connected to said friction plate, said bearing assembly having a bearing assembly axis; and

at least one of said friction plate axis, said screw drive assembly axis, or said bearing assembly axis being offset from the clutch axis.

32. The actuator system according to claim 31, said offset creating a first torque biasing said screw drive assembly in a first direction.

33. The actuator system according to claim 32, said offset creating a second torque biasing said screw drive assembly in a second direction.

34. The actuator system according to claim 33, wherein said first torque is balanced with said second torque.

35. The actuator system according to claim 34, said worm gear reduction assembly mediating axial travel of said friction plate.

Coaxial Friction Clutch Actuator System

ABSTRACT OF THE INVENTION

A controlled actuator system for the actuation of a friction clutch comprising a screw drive assembly coaxial with an axis of the clutch composed of a collar and a screw fastened to a gearbox. The controlled actuator system having a friction plate rotatably fastened to control fingers of the clutch and coaxial with the clutch axis and a ball bearing assembly with a first race fastened to the collar and the axis of the bearing assembly being offset from the axis of the clutch. The collar is rotated by a motor. The friction plate and a second race of the bearing assembly are in frictional engagement.